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Claims

1. A method carried out by a programmed computer for planning routes by a user in the presence of hazards, comprising;
receiving data representing a route for a vehicle;
receiving data representing hazards associated with the route, the hazards having a plurality of different types;
displaying geographic representations of the route data and the hazard data together; and
inputting and displaying specifications from the user for at least some of the displayed hazard data.

2. The method of claim 1 where the route is a flight plan for an aircraft.

3. The method of claim 2 where the flight plan includes a plurality of waypoints.

4. The method of claim 1 where the specifications include boundaries of areas representing at least one of the hazards.

5. The method of claim 4 where the boundaries are polygons.

6. The method of claim 1 where the specifications include data relating to motion of at least one of the hazards.

7. The method of claim 6 where the data relating to motion comprises direction and speed of the one hazard.

8. The method of claim 6 further comprising varying the time at which the hazards are depicted in the display

9. The method of claim 1 where hazard types include weather hazards.

10. The method of claim 9 where the displayed hazard data represents different hazard types differently.

11. The method of claim 9 where the displayed hazard data represents different hazard intensities differently.

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~~12~~. The method of claim 1 where the geographic representations are displayed in a lateral depiction.

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~~13~~. The method of claim 1 where the geographic representations are displayed in a vertical depiction.

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~~14~~. The method of claim 1 where inputting the specifications from the user comprises receiving inputs from a set of controls operable by the user.

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~~15~~. The method of claim ~~14~~ where the controls include a control for varying the time at which the hazards are depicted in the display.

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~~16~~. The method of claim ~~14~~ where the controls include at least one control to establish a threshold for an intensity of a hazard to be avoided by the route.

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~~17~~. The method of claim 1 further comprising producing the received route data by optimizing a cost function for the route.

Sub 2
18. A medium containing program instructions for causing a suitably programmed digital computer to carry out a method for planning routes in the presence of hazards, the method comprising:

receiving data representing a route for a vehicle;

E receiving data representing hazards associated with the route, the hazards having a plurality of different types;

displaying geographic representations of the route data and the hazard data together; and

inputting and displaying specifications from the user for at least some of the displayed hazard data.

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¹⁸ ~~19~~. The medium of claim ~~18~~ where the medium comprises a storage medium.

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¹⁹ ~~20~~. The medium of claim ~~18~~ where the medium comprises signals.

Sub A 3
21. A computer-implemented system for planning routes in the presence of hazards, comprising:

data representing a route for a vehicle;

data representing hazards with respect to the route, the hazards having a plurality of different types; and

an interface including
a geographic display of the hazard data and the route data, and
controls for manipulating the route data and the hazard data, and for
inputting specifications associated with at least some of the hazards;

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22. The system of claim ²⁰21 where the vehicle is an aircraft.

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23. The system of claim ²⁰21 where the specifications include boundaries of areas
representing at least one of the hazards.

²³
24. The system of claim ²²23 where the boundaries are polygons.

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25. The system of claim ²⁰21 where the specifications include data relating to motion over
time of at least one of the hazards.

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26. The system of claim ²⁴25 where the data relating to motion comprises direction and
speed of the one hazard over time.

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27. The system of claim ²⁰21 where the route data includes data for a plurality of
alternative routes.

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28. The system of claim ²⁰21 where the route data includes a plurality of waypoints.

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29. The system of claim ²⁰21 where hazard types include weather hazards.

30. The system of claim 29 where the displayed hazard data represents different hazard
types differently.

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31. The system of claim ²⁴29 where the displayed hazard data represents different hazard
intensities differently.

³⁰
32. The system of claim ²⁰21 where the geographic representations are displayed in a lateral
depiction.

³¹
33. The system of claim ²⁰21 where the geographic representations are displayed in a
vertical depiction.

³²
34. The system of claim ²⁰21 where inputting the specifications from the user comprises receiving inputs from a set of controls operable by the user.

³³
35. The system of claim ³²34 where the controls include a control for varying the time at which the hazards are depicted in the display.

³⁴
36. The system of claim ³²34 where the controls include at least one control to establish a threshold for an intensity of a hazard to be avoided by the route.

³⁵
37. The system of claim ²⁰21 further comprising an optimizer for producing the received route data.

³⁶
38. Apparatus for manipulating a flight plan by a user, comprising:
means for receiving data representing an aircraft route;
means for receiving data representing hazards with respect to the route;
means for a user to input specifications associated with the hazards; and
means for presenting geographic representations of the route data, the hazard data, and the boundaries.

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39. The apparatus of claim ³⁶38 where the apparatus comprises a programmed computer.

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40. The apparatus of claim ³⁶38 where the presenting means includes a visual display.

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41. The apparatus of claim ³⁶38 where the input means includes a cursor-positioning device.

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42. The apparatus of claim ³⁶38 where the hazard receiving means includes a communications device.

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43. The apparatus of claim ³⁶38 further comprising an optimizing means for minimizing the cost of the route in response to the specifications input by the user.

⁴²
44. A computer-implemented system for planning routes (410), in which data (110) associated with a route and data (120) associated with hazards are represented on an interface (130),

characterized in that the interface displays the route data and the hazard data together geographically (401, 402) and includes controls (450, 480) for manipulating the displayed route (410) and hazards (420).

45. A system according to claim 44, characterized in that the controls receive specifications from a user concerning the hazards.

46. A system according to claim 45, characterized in that the specifications include boundaries (430) of areas representing at least one of the hazards.

47. A system according to claim 46, characterized in that the boundaries are polygons.

48. A system according to claim 46, characterized in that the specifications include motion parameters (226) of at least one of the hazards.

49. A system according to claim 44, characterized in that the hazard types include multiple types of weather hazards (421-429).

50. A system according to claim 49, characterized in that different types of weather hazards are displayed differently.

51. A system according to claim 49, characterized in that different intensities of the same weather hazards are displayed differently.

52. A system according to claim 49, characterized in that the user can set a number of thresholds for different types of the weather hazards.

53. A system according to claim 44, characterized in that the geographic display is a lateral depiction (401).

54. A system according to claim 44, characterized in that the geographic display is a vertical depiction (402).

55. A system according to claim 44, characterized in that the hazard data is displayed temporally as well as geographically.

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~~56~~. A system according to claim ⁴²~~44~~, characterized in that the route data is optimized while avoiding at least certain of the hazards.

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~~57~~. A system according to claim ⁵²~~56~~, characterized in that the route data has a minimum cost function with respect to certain factors .